DISCOVERY

Monitoring Peri-urbanization in Ibadan Region: Case studies of Akinyele, Egbeda, Ido and Oluyole local government areas

Kolade Victor Otokiti[1]✉, **Apolola Ayoola Collins**[1], **Ayomide Samuel Famewo**[2], **Rukayat Tolase Raheem**[3]

[1]Deparment of Urban and Regional Planning, Federal University of Technology, Akure, Nigeria.
[2]Department of Urban and Regional Planning, Faculty of Environmental Design and Management, University of Ibadan, Ibadan Nigeria.
[3]Department of Cultural and Media Studies, University of Ibadan, Ibadan Nigeria.

✉**Corresponding Author:**
Email: otokitikolade@gmail.com

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ABSTRACT

This study analyzed the magnitude and patterns of urban expansion (built-up area) in Ibadan peri-urban areas (Akinyele, Egbeda, Ido and Oluyole Local Government Areas) between 1986 to 2019 using Landsat-5 (TM) and Landsat-8 (OLI/TIRS) images. Across the study areas, our results, on the one hand, show an increase in the built-up area, rock and bare soil, and grassland area, while, on the other hand, they reveal a decrease in forest and open space over the study period. Respectively, the built-up area increased by 306.34%, 317.16%, 243.66% and 400.80% in Akinyele, Ido, Egbeda and Oluyole Local Government Areas. Having established built-up expansion in Ibadan peri-urban areas, this study; however, recommends that comprehensive planning focus on the peri-urban areas is required to arrest urban sprawl and its corresponding adverse impacts.

Keywords; Peri-urbanization, Landsat, Ibadan, Akinyele, Ido, Oluyole, Egbeda

1. INTRODUCTION

Urbanization and population growth is a global phenomenon usually accompanied by a series of wide-ranging detrimental effects (Singh et al., 2013) including greenhouse gas emissions, water pollution, environmental pollution (Coutts et al., 2010), climate change (Adeniran et al., 2020), deforestation (Otokiti et al., 2019a), agricultural land loss (Otokiti et al., 2020), flooding (Otokiti et al., 2019b, Adeniran et al., 2020), and urban heat island (Thi Van and Bao, 2010) among others. Currently, urban areas house more than

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50% of the global population, and it is projected, by previous studies, that by 2050, the proportion of urban dwellers would be 70% with a remarkable addition from Africa (United Nations, 2014).

Urbanization rate in Nigerian cities has been noticeably high as it ranks with other fastest-growing regions in the world (Jiboye, 2011). This phenomenon is expected to have a spillover effect on peri-urban areas leading to land use/cover change and environmental degradation (Bhat et al., 2017) due to migration from the core city to the peri-urban areas (Otokiti et al., 2019a; Cobbinah and Darkwah 2016). Peri-urban areas are often desired for developmental purposes because of the relatively affordable rent (Lawanson et al., 2012, Acheampong and Anokye, 2013), benefits of subsidies and access to the city (Amoateng et al., 2013). However, peri-urbanization remains a serious concern to urban stakeholders due to its potentially detrimental effect on sustainable development (Sun et al., 2013).

According to Olajuyigbe (2016), due to sprawling growth of cities, peri-urban areas in developing countries are marked by many challenges such as unsystematic development patterns, unsustainable urbanization, poor management of natural resources, marginal land encroachment and proliferation of informal settlements. All these challenges are intrinsically linked with environmental degradation and low quality of life. In this regard, the need for monitoring land use/cover in peri-urban areas becomes a necessity. Land use/cover analysis using remote sensing (RS) satellite data have been widely used in documenting and understanding the effect of urban growth (Jin et al., 2017, Otokiti et al., 2019a, Otokiti et al., 2019b, Adeniran et al., 2020, Otokiti et al., 2020), as well as serving as a vital source of information for planning, mitigation and management of the aforementioned impacts (Read and Lam, 2002). Exemplarily, Landsat satellite data provide fascinating opportunities to extract information about the magnitude of urban land use/cover in peri-urban areas (Otokiti et al., 2019a).

Over the last several decades, Ibadan has grown persistently both in population and physical size (Adelekan et al., 2014). This growth has resulted in the rapid transformation of the peri-urban landscape into urban-oriented land uses. The study of Otokiti et al. (2019a) modelled peri-urbanization in two peri-urban areas in Ibadan. However, the uniqueness of this study lies in the fact that it evaluates the magnitude and patterns of peri-urbanization in four Ibadan Local Government Areas -Akinyele, Ido, Egbeda and Oluyole - between 1986-2019. By studying more LGAs, this study is expected to have a profound impact on the development of a sustainable land use plan and development in the study areas.

2. MATERIALS AND METHODS

2.1. Research Locale

The study areas are in Ibadan, the capital of Oyo State. It is the most populated metropolitan area in Nigeria with a population of 2,550,593 (National Population Census, 2006) after Lagos and Kano. Also, it is one of the largest cities in Africa. For administrative and governance purposes, Ibadan is an embodiment of 11 local government areas (LGAs). Six out of these Local Government Areas fall into peri-urban or rural areas, while the other five comprises the urban LGAs (Dar-Al-Handasah, 2018). Change in Land use pattern within the urban and peri-urban areas of the city has been attributed to urban sprawl due to the exponential growth of commercial and industrial activities (Fourchard, 2003). For this study, four LGAs out of the six LGAs those makeup Ibadan peri-urban areas were selected. The Local Government Areas are Akinyele, Ido, Egbeda, and Oluyole. They represent the North, West, East and South of Ibadan urban areas respectively.

Akinyele LGA is one of the six LGAs that makeup Ibadan peri-urban area. It occupies a land area of about 478.16 sq.km., and it is bounded by Afijio LGA, Lagelu LGA, Ido LGA and Ibadan North LGA. It is situated between Latitude 7°24'0" N, 7°39'0" N and Longitude 3°45'0" E, 4°6'0" E of the equator. International Institute for Tropical Agriculture (IITA), Federal School of Statistics and National Institute of Social and Economic Research (NISER) are major landmarks in the LGA. The major occupation in Akinyele LGA is farming; although, some of the inhabitants are petty traders, local engineers, civil servants etc. Largely, the area is dominated by the Yorubas, but other tribes dwellin the LGA. Along this line, migrants from neighbouring African countries such as Togo and Benin Republic who have come to take advantage of the fertile agricultural land have been identified in the study area (Alawode and Abegunde, 2015).

Ido LGA is located between Latitudes $7^0$15'0" N, 7°45'0" N, and Longitudes 3°30'0" E, 3°52'0" E. The total land area of the LGA is about 1065.90 sq. km. It shares a boundary with Iseyin LGA to the North, Akinyele LGA to the East, Odeda LGA (in Ogun State) to the South and Ibarapa East LGA to the West. According to the National Population Census (2006), the Local Government has a population of about 272,000 people. The inhabitants are mainly farmers, while the secondary occupation includes trading, fabrication, artisans, civil service and food processing among others (Olajide, 2011).

Egbeda LGA shares boundary with Lagelu LGA, Irewole LGA (in Osun State), Ona-Ara LGA and Ibadan North LGA to the North, East, South and West respectively. The LGA has a population of 281,573 inhabitants (National Population Census, 2006). Egbeda LGA covers about 188.34 sq. km. in terms of land area and is located between Latitudes 7°2'0" N, 7°20'0" N and Longitude 3°43'0" E and

4°1'0" E. Oluyole LGA occupies an area of 761 sq. km. with a population of 202,725 (National Population Census, 2006). It is located approximately on Latitudes 7°3'0" N, 7°21'0" N and Longitudes 3°42'0" to 4°3'0" E.

2.2. Methods

The study examined peri-urbanisation in Ibadan by using RS data (Landsat images) obtained from the website of the United States Geological Survey (https://earthexplorer.usgs.gov). Particularly, the study used the 1986 (Landsat-5) and 2019 (Landsat-8) Landsat images for the four LGAs. The acquired images were then analysed using ArcMap 10.3 software. Thus, six (6) land-use/land-cover (LULC) types were identified, including rock/bare soil, forest, open space, built-up, grassland and waterbody. The Land-use Land cover (LULC) maps were developed using the maximum likelihood algorithm supervised classification. The Land-use Land cover (LULC) map was later ground-truthed for verification. After completing the land cover classification, the area of each class was determined and converted to square kilometers and percentages. Based on the classification, the red colour depicts the built-up areas, dark blue for a waterbody; dark green for the forest; light green signifies grassland; brown for rock/bare soil; and yellow for open space.

Change detection analysis was conducted over the 33 years of study to determine the change in the extent of the identified LULC classes as well as magnitude of peri-urbanization in the study areas.

3. RESULTS

3.1. Akinyele LGA

3.1.1 Assessment of LULC Dynamics

The level of peri-urbanization in Akinyele LGA as of 1986 was presented in Figure 1. The area statistics of the LULC classified map of 1986 revealed that forest occupied the largest percentage share of the area (79.90%, 382.04 sq.km.). Besides, it is found in every part of the LGA except the southern part. Grassland comes second after the forest (7.03%, 33.64 sq. km). It is scattered around the LGA with more patches around the northern part of the LGA. Open space is next in area coverage (6.25%, 29.88 sq.km.) and is more predominant in the southern part of the LGA. The built-up area (5.90%, 28.2 sq.km.) coming distant fourth is nucleated mainly around the southern part of the LGA. Waterbody and Rock/Bare soil have respective percentage coverage of 0.14% (0.66 sq. km.) and 0.78% (3.73 sq. km.).

In 2019, the LULC classified map developed for Akinyele LGA (Figure 2) showed that grassland (51.64%, 246.91 sq.km.), built-up (23.80%, 114.63 sq.km.) and rock/bare soil (14.24%, 68.09 sq.km.) relegated forest (9.91%, 47.41 sq.km.) to the fourth-largest share of the LGA. However, open space had been totally consumed while waterbody with0.23% (1.12 sq.km.) of the total land area covers the least percentage share (Table 1).

Table 1: LULC classes and Area statistics for Akinyele LGA by year of investigation

LULC Classes	1986		2019	
	Landcover (sq. km)	**%**	**Landcover (sq. km)**	**%**
Rock/Bare soil	3.73	0.78	68.09	14.24
Forest	382.04	79.90	47.41	9.91
Open Space	29.89	6.25	0	0
Built-Up	28.21	5.90	114.63	23.97
Grass Land	33.64	7.03	246.91	51.65
Water Body	0.66	0.14	1.12	0.23
Total	**478.16**	**100**	**478.16**	**100**

3.1.2 Magnitude and Pattern of Peri-urbanization

Table 2 reveals the change in the size of the six LULC over the 33 years of the study in Akinyele LGA. All the LULC experienced an increase in their land coverage area except forest and open space. Grassland experienced the largest increase in the coverage area with about 213.27 sq. km (633%). Built-up experienced an increase in the coverage areawith86.42 sq. km (306%), while rock/bare soil experienced 64.36 sq. km (1725%) increase in the coverage area. Furthermore, water body increased by about 0.46 sq. km (69%). While open space was completely depleted, forest experienced the largest decline in the coverage area losing about 334.63 sq. km. Based on this, it could be inferred from Table 2 that open space and forest land cover classes play a critical role in the percentage increase observed in the built-up area as a result of peri-urbanization. A significant part of the built-up (considered to be as a result

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of peri-urbanization) was concentrated in the southern and central parts of the peri-urban area. Our result revealed that over one-fifth (23.97%) of the LGA has been peri-urbanized (Table 1).

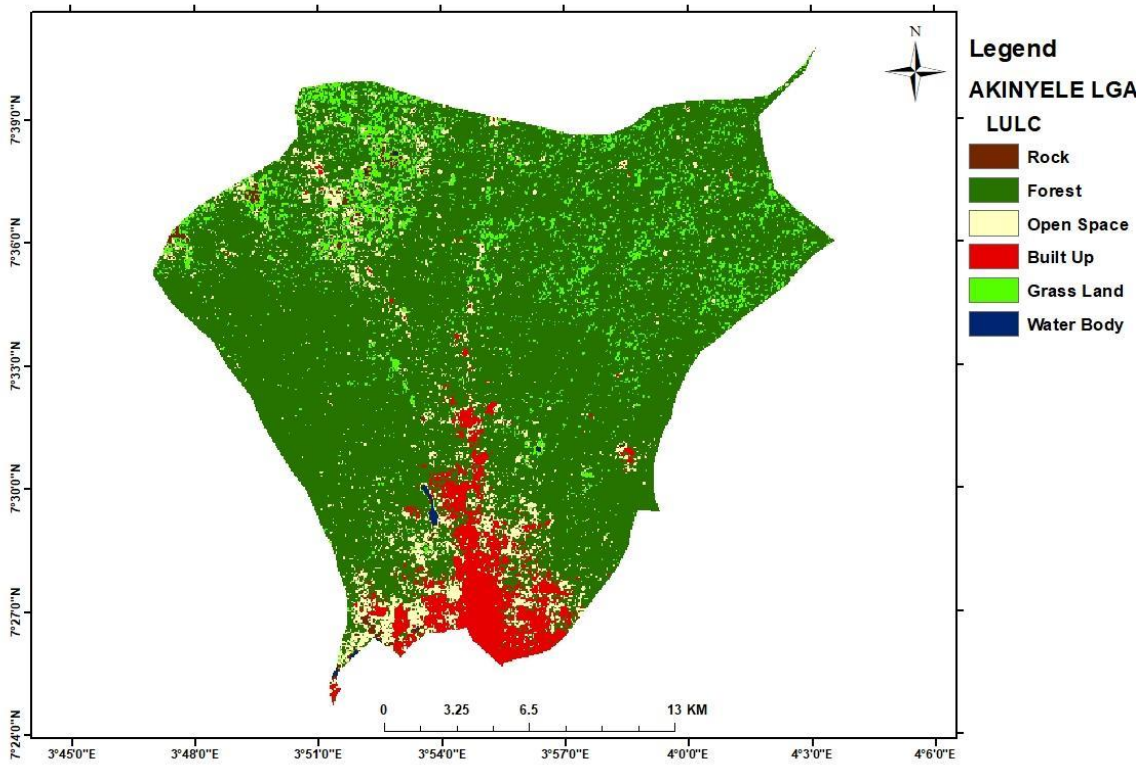

Figure 1: Classified map developed for Akinyele LGA based on Landsat-5 for the year 1986.

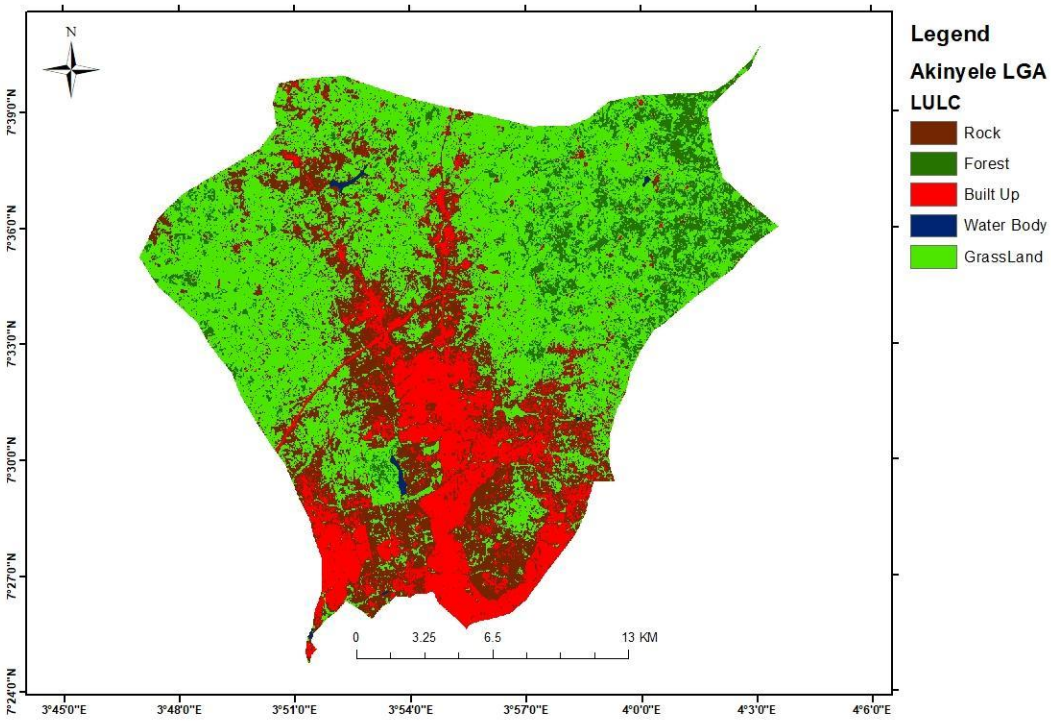

Figure 2: Classified map developed for Akinyele LGA based on Landsat-8 for the year 2019.

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Table 2: Changes in Area statistics for LULC class in Akinyele LGA from 1986-2019

	The Year 1986 – 2019			
LULC class	**Area Losses(sq.km)**	**Area Gains(sq.km)**	**Area Losses (%)**	**Area Gains (%)**
Forest	-334.63	0	87.59	0
Grassland	0	213.27	0	633.97
Open Space	29.89	0	100	0
Built-Up	0	86.42	0	306.34
Rock/Bare soil	0	64.36	0	1725.46
Water Body	0	0.46	0	69.69

3.2. Ido LGA

3.2.1 Assessment of LULC Dynamics

The classified map, as presented in Figure 3, revealed the level of peri-urbanization in Ido LGA in 1986. Forest covered 55.17% (588.0286 sq.km.) of the total land area; thereby, making it the most dominant land cover in the LGA during this period. This is found largely in the northern and eastern part of the LGA. After forest is rock/bare soil with17.14% (181.59 sq.km.) of the total coverage area. This is followed closely by grassland covering 15.94% (169.94 sq.km.) of the LGA. The area covered by open space comprises 9.58% (102.15 sq. km) of the total land area. Built-up and water body constitute, respectively, land area coverage of1.86% (19.81 sq.km.) and 0.41% (4.38 sq.km.).While the latter scattered over northern and southern parts of the LGA, the former was dominant at the southern part of the LGA.

However, in 2019, rock/bare soil was the most dominated LULC in the LGA with 48% (520.33 sq. km) of the total land area. Grassland came second with40% (434.89 sq.km.) of the total land area. As revealed by Figure 4, the built-up area gained more dominance in the Eastern part of the study area, and it forms 7.75% (82.64 sq.km.) of the total land coverage of the LGA. However, some patches built-up areas scattered around the northern and western part of the LGA were equally identified. A drastic increase in built-up land footprint was observed in LULC classified map with remarkable depletion of forest. Forest footprint was just 2.60% (27.76 sq. km) in 2019 with some patches scattered in the eastern and northern part of the LGA. Water witnessed a decline in land cover as well. Nonetheless, it still covered 0.03% (0.29 sq.km.) of the LGA. Like the case of Akinyele LGA in 2019, open space was totally consumed.

Table 3: LULC classes and Area statistics for Ido LGA by year of investigation

LULC Classes	**1986**		**2019**	
	Landcover (sq. km)	**%**	**Landcover (sq. km)**	**%**
Rock/Bare soil	181.59	17.04	520.33	48.82
Forest	588.03	55.17	27.75	2.60
Open Space	102.15	9.58	0	0
Built-Up	19.81	1.86	82.64	7.75
Grassland	169.94	15.94	434.89	40.80
Waterbody	4.38	0.41	0.29	0.03
Total	**1065.90**	**100**	**1065.90**	**100**

3.2.2 Magnitude and Pattern of Peri-urbanization

Table 4 reveals the change in the size of the six LULC over the 33-year period of the study in Ido LGA. The study showed that all LULC classes experienced an increase in the land coverage area except forest, water body and open space. Built-up land, Rock/Bare soil and Grassland underwent a massive change as they expanded by 62.83 sq. km (317%), 338.74 sq. km (186.54%) and 264.95 sq. km (155.90%). Accordingly, forest lost 560.30 sq. km (95%) of its land expanse, water body lost 4.08 sq. km (93%) of its expanse, but the open space was entirely lost. The exploitation of the forest, waterbody and open space was partly due to peri-urbanization where built-up area exhibits a remarkable footprint in the south-western part of the LGA. Nevertheless, the magnitude of peri-urbanization could still be regarded as low as it represents just 7.75% of the land area (Table 3).

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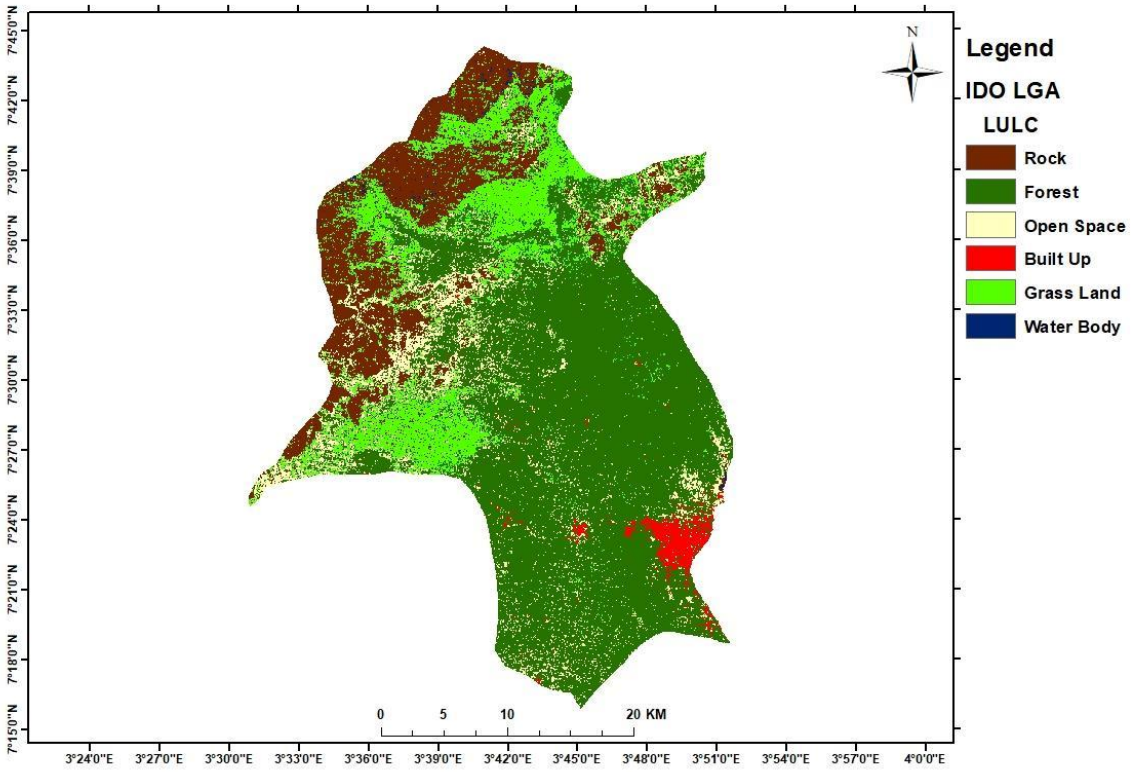

Figure 3: Classified map developed for Ido LGA based on Landsat-5 for the year 1986

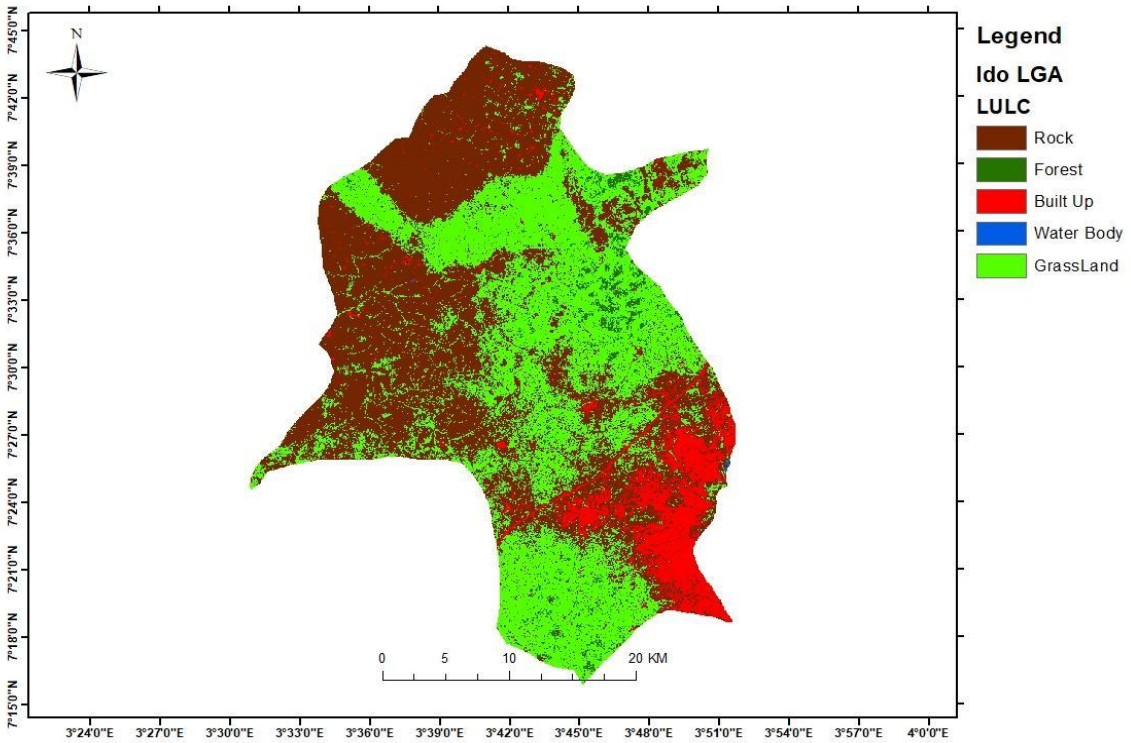

Figure 4: Classified map developed for Ido LGA based on Landsat-8 for the year 2019

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Table 4: Changes in Area statistics for LULC class in Ido LGA from 1986-2019

	The Year 1986 – 2019			
LULC class	**Area Losses (sq.km)**	**Area Gains (sq.km)**	**Area Losses (%)**	**Area Gains (%)**
Forest	-560.30	0	95.30	0
Grassland	0	264.95	0	155.90
Open Space	-102.15	0	100	0
Built-Up	0	62.83	0	317.16
Rock/Bare soil	0	338.74	0	186.54
Water Body	-4.08	0	93.34	0

3.3. Egbeda LGA

3.3.1 Assessment of LULC Dynamics

The land cover result generated from LULC analysis (Figure 5) revealed that in 1986, the forest had 61.83% (116.44 sq.km.) share of the total land area. Forest was found predominant in the northern, southern, eastern and western part of the LGA. Open space was next with15.90% (29.95 sq. km) of the total land area. With some patches of open space scattered around the LGA, it was found in the northern and western part of the LGA. Grassland class covered about 10.79% of the total land area (20.31 sq.km.). With this, grassland cover class comes third after the forest and open space land cover classes. The built-up land cover class comes after the grassland, and it was largely in the western part of the LGA with about 7.40% (13.93 sq.km.) share of the total land area. Rock/Bare soil is the fifth-largest land cover class in the LGA with 3.34% (6.30 sq. km) of the land area. Water occupied the least area in terms of spatial coverage and it was mainly concentrated in the eastern part of the LGA with about 0.74% (1.39 sq.km.) share of the study area.

In 2019, the classified map of Egbeda LGA (Figure 6) revealed that, grassland area with 43.84% (82.57 sq.km.) is the largest land cover class in the LGA. Grassland area is found mainly in the eastern, southern and northern part of the LGA. However, a small part of it was found in the western part of the LGA. The next land cover class with the highest land area coverage after grassland is the built-up land cover class with 25.36% (47.77 sq.km.) of the total land area. The built-up land cover class forms the largest land area in the western part of the LGA. Rock/bare soil land cover class comes third after the grassland and built-up land cover class with an estimation of 23.86% (44.93 sq.km.) of the LGA's spatial extent. Rock/bare soil land cover class was observed around the built-up land cover class. Forest and water land cover class come after rock/bare soil land cover class respectively. The former constitutes 6.22% (11.72 sq. km) of the LGA while the latter makes up 0.72% (1.35 sq. km) of the total land area in the LGA. unfortunately, the open space was totally consumed.

Table 5: LULC classes and Area statistics for Egbeda LGA by year of investigation

LULC Classes	**1986**		**2019**	
	Landcover (sq. km)	**%**	**Landcover (sq. km)**	**%**
Rock/Bare soil	6.30	3.34	44.93	23.86
Forest	116.44	61.83	11.72	6.22
Open Space	29.95	15.90	0	0
Built-Up	13.9	7.40	47.77	25.36
Grassland	20.31	10.79	82.57	43.84
Waterbody	1.39	0.74	1.35	0.72
Total	**188.34**	**100**	**188.34**	**100**

3.3.2 Magnitude and Pattern of Peri-urbanization

Table 6 reveals the change in the size of the six LULC over the 33yearsof the study in Egbeda LGA. The spatial extent covered by forest, open space and water land cover classes experienced negative change. Forest land cover class experienced a significant decline in land area, losing Over 89% (104.73 sq. km) of its total coverage area. Similarly, open space and water experienced loss in spatial extent losing 100% (29.95 sq.km.) and 97.08% (0.04 sq.km.) respectively. However, the grassland area experienced a tremendous increase in size as it expanded by 62.26 sq. km (306%) while built-up area and rock/bare soil expanded by 33.87 sq. km (243%) and 38.63 sq. km (613%) respectively. From 1986-2019, the built-up area increased from 13.9 to 47.77 sq.km., suggesting an

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expansion of urban-oriented activities into the LGA (peri-urbanization). It was observed from Figure 6 that the Western part of the LGA is mostly covered by built-up land. Based on Table 5, over one-fourth (25.36%) of the LGA has been peri-urbanized.

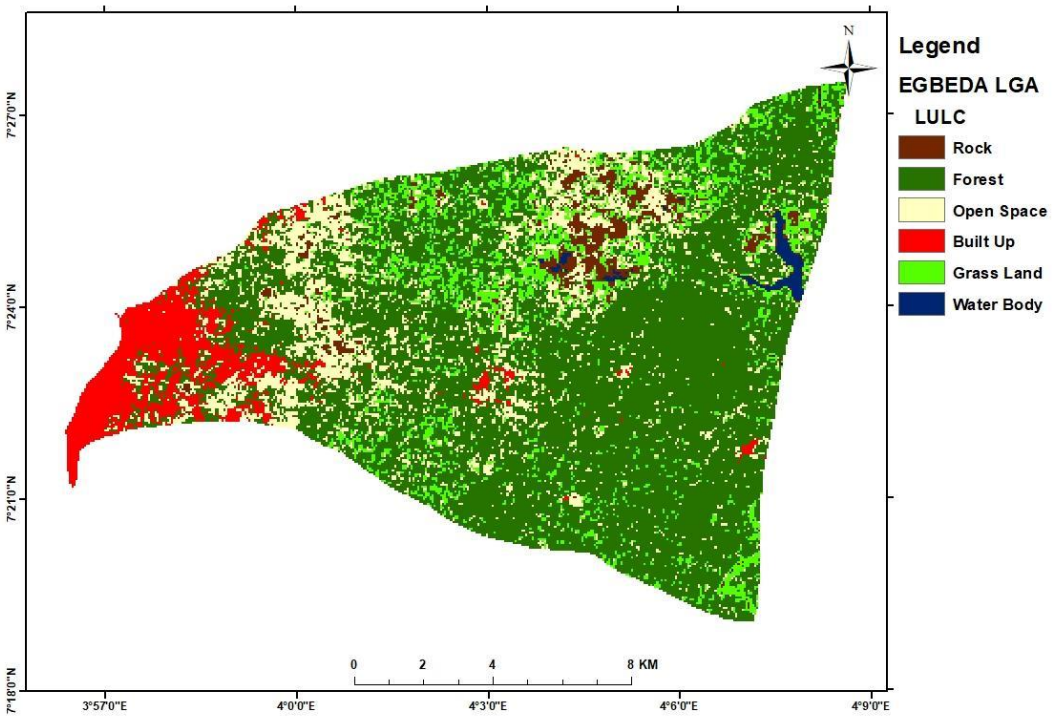

Figure 5: Classified map developed for Egbeda LGA based on Landsat-5 for the year 1986

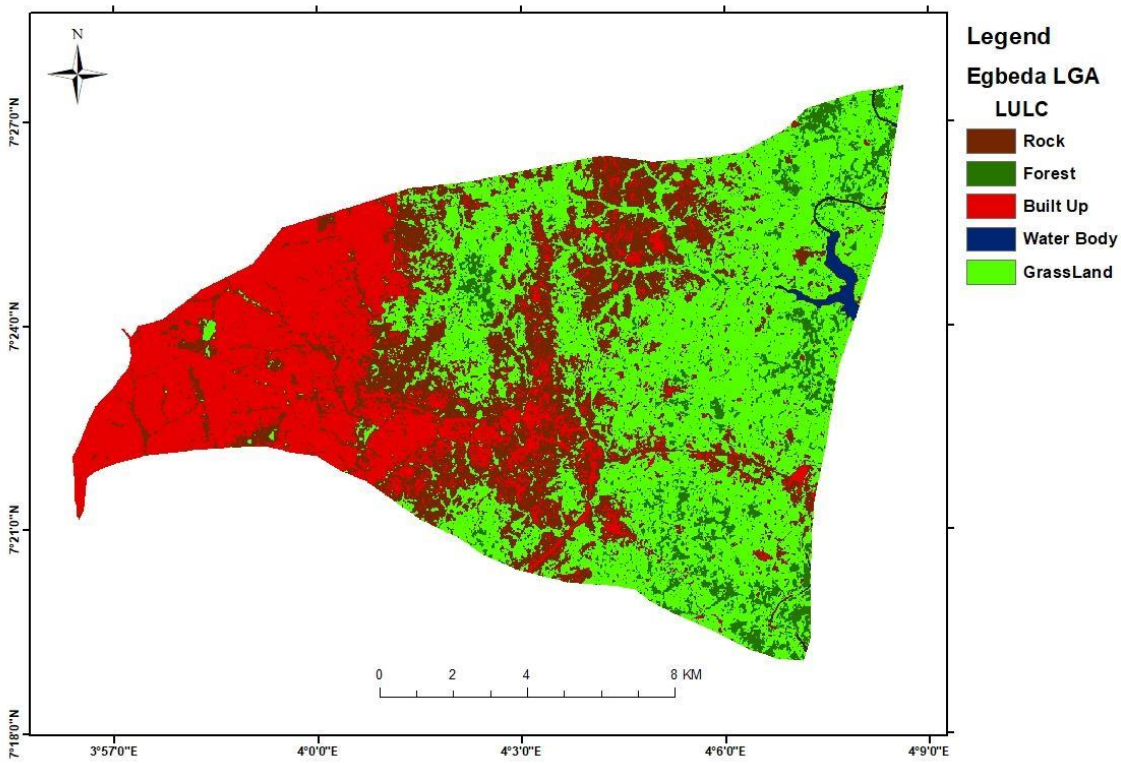

Figure 6: Classified map developed for Egbeda LGA based on Landsat-8 for the year 2019

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Table 6: Changes in Area statistics for LULC class in Egbeda LGA from 1986-2019

	The Year 1986 – 2019			
LULC class	**Area Losses(sq.km)**	**Area Gains(sq.km)**	**Area Losses(%)**	**Area Gains(%)**
Forest	-104.73	0	89.94	0
Grassland	0	62.26	0	306.54
Open Space	-29.95	0	100	0
Built-Up	0	33.87	0	243.66
Rock/Bare soil	0	38.63	0	613.17
Water Body	-0.04	0	97.08	0

3.4. Oluyole LGA

3.4.1 Assessment of LULC Dynamics

The LULC classified map (Figure 7) of Oluyole LGA (1986) revealed that forest was the most dominant land cover class in the LGA, covering 74.60% (568.08 sq.km.) of the total land area. Forest land cover class was found in the northern, eastern, western and southern parts of the LGA. Open space was dominant around the central part of the LGA with some patches dispersed across the LGA. Open space covers 14.76% (112.43 sq.km.) of the total area; thereby, making it the second-highest land cover class in the LGA as of 1986. Grassland covers 9.38% (71.44 sq.km.) of the LGA where it was largely concentrated at the Eastern part of the LGA. Built-up was found at the northern, western and southern part of the LGA where it constitutes 0.98% (7.43 sq.km.) of the total land area. With lack of waterbody in the LGA, rock/bare soil comprises 0.28% (2.15 sq.km.) of the total land area in the LGA.

The result of the LULC (Figure 8) analysis revealed that the largest percentage of the land cover in Oluyole LGA was covered by grassland area (Table 7) with over 52% (402.06 sq.km.) of the total land area. Grassland in the LGA concentrated more in the southern part; though, it was equally identified at the western, northern and eastern part of the LGA. Forest land cover class covers about 30.42% (231.70 sq.km.) of the total land area. The larger percentage of forest land cover class represents the eastern part of the LGA. Rock/Bare soil forms about 11.85% (90.27 sq.km.) of the total land area. A substantial percentage of this land cover class was found around the built-up area in the northern part of the LGA. The built-up land cover class was found mainly at the northern part of the LGA with some patches at the eastern and western part of the LGA. It constitutes about 4.90% (37.20 sq.km.) of the total land area. In Table 7, the water body is 0% of the total land area in 1986. But in 2019, waterbody constitutes more than 0.03% (0.30 sq.km). This size is as a result of growing fish farming in the LGA (Sanusi et al., 2016). Lastly, the open space was totally exploited.

Table 7: LULC classes and Area statistics for Oluyole LGA by year of investigation

LULC Classes	**1986**		**2019**	
	Landcover (sq. km)	**%**	**Landcover (sq. km)**	**%**
Rock/Bare soil	2.15	0.28	90.27	11.85
Forest	568.08	74.60	231.70	30.42
Open Space	112.43	14.76	0	0
Built-Up	7.43	0.98	37.21	4.90
Grassland	71.44	9.38	402.06	52.80
Waterbody	0	0	0.30	0.04
Total	**761.54**	**100**	**761.54**	**100**

3.4.2 Magnitude and Pattern of Peri-urbanization

Table 8 reveals the change in the size of the six LULC over the 33years of the study in Oluyole LGA from 1986 to 2019. Grassland spatially exploded as it expanded by 330.62 sq. km (462%), rock/bare soil expanded by 88.12 sq. km (4098%); built up LULC expanded by 29.78 sq. km (400%); and water body LULC that was not in existent in 1986 became evident in 2019 with a recorded gain of 0.30 sq. km (30%). Forest and open space experienced a decline in the total land coverage area. Forest LULC lost 336.38 sq. km. (59%), while open space was entirely lost. It was observed in the analysis that developed lands (built-up) were mostly found in the northern part of the LGA. It could be deduced from the visual analysis made on the image (Figure 8) that the magnitude of peri-urbanization is low as it represents just 4.90% (Table 7) of the land area.

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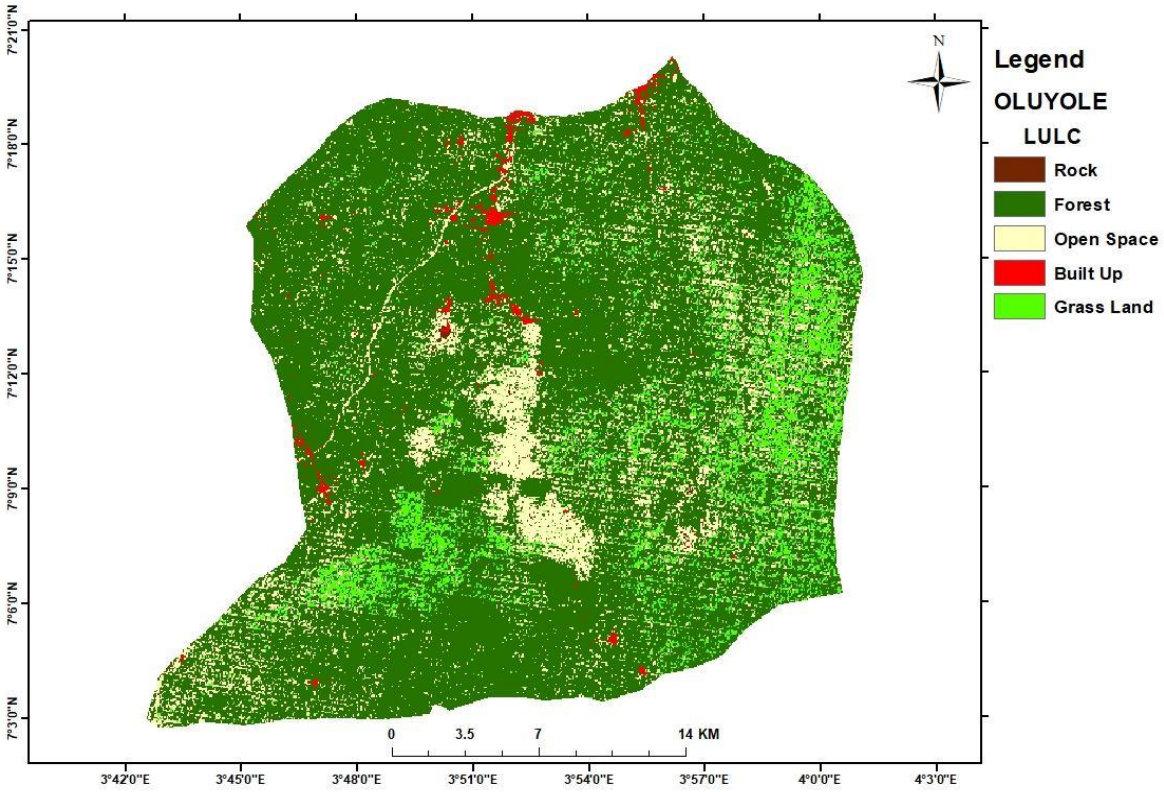

Figure 7: Classified map developed for Oluyole LGA based on Landsat-5 for the year 1986

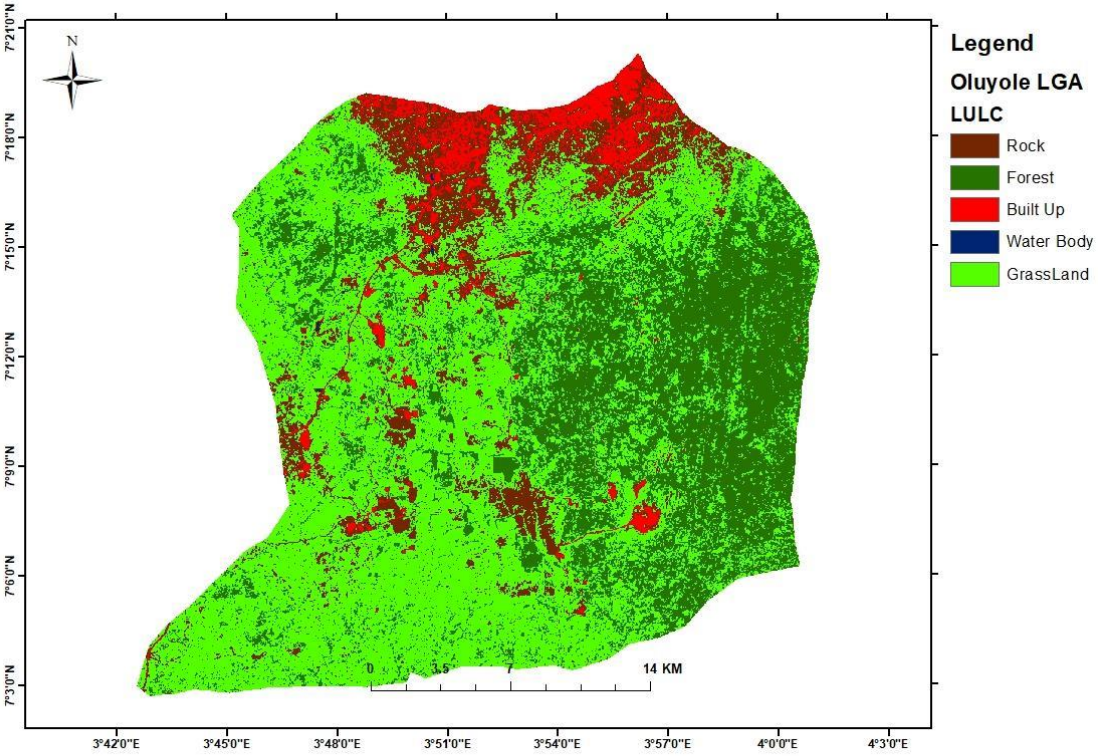

Figure 8: Classified map developed for Oluyole LGA based on Landsat-8 for the year 2019

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Table 8: Changes in Area statistics for LULC class in Oluyole LGA from 1986-2019

	The Year 1986 – 2019			
LULC class	**Area Losses (sq.km)**	**Area Gains (sq.km)**	**Area Losses (%)**	**Area Gains (%)**
Forest	-336.38	0	59.21	0
Grassland	0	330.62	0	462.79
Open Space	-112.42	0	100	0
Built-Up	0	29.78	0	400.80
Rock/Bare soil	0	88.12	0	4098.60
Water Body	0	0.30	0	30

4. DISCUSSION

The study presents the magnitude and pattern of peri-urbanization in Ibadan. Evidently, human settlement expansion (resulting from urban sprawl) coupled with increment in grassland (essentially agricultural lands) and Rock/Bare soils were uniform to the studied LGAs over the studied period. This phenomenon is expected because as urban development encroaches into peri-urban areas, the need for resources to satisfy human wants increases, eventually leading to the creation of new areas and cultivation of fertile lands. This assertion is supported by the study of Parsa and Salehi (2016) where the growth of built-up areas was accompanied by the expansion of agricultural land in Naghadeh, Iran.

5. CONCLUSION

The findings presented in this study provide the required baseline information required for sustainable development and land use planning. This study shows the magnitudes and patterns of peri-urbanization across the four peri-urban LGAs in Ibadan from 1986 to 2019 using Geographic Information System (GIS) and Remote Sensing tools. Having established persistent increase in built-up land, Grassland area and rock/bare soil LULC, it becomes apparent that the existing Forest area and water body should be protected against further degradation to preserve the ecosystem and to avoid more adverse effect from climate change in the subsequent years. Accordingly, appropriate planning focus on the peri-urban areas is needed in guiding against urban sprawl and its corresponding adverse impacts.

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Conflict of Interest

The authors declare no conflicts of interests any matter related to this paper.

Data and materials availability

All related data have been presented in this paper.

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